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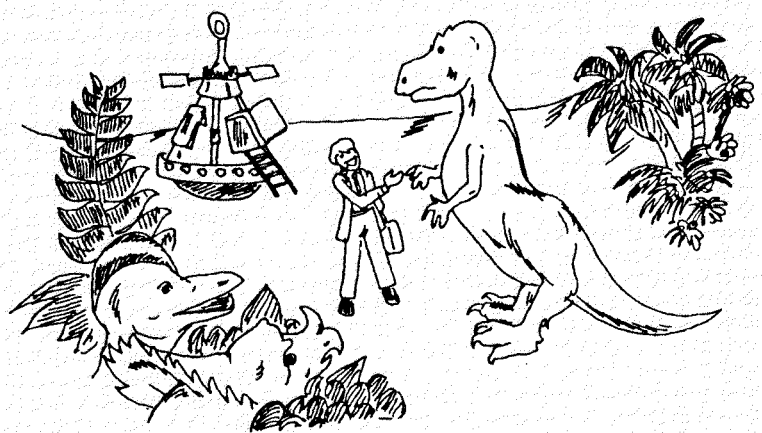

Says he's a creationist and he's looking for a date . . .

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About this issue . . .

A glance at an old issue of *C/E* (No. 22) reveals an intro line, "With the demise of the Paluxy River footprints as the best example of 'hard evidence' for creationism, most creationists have turned their attention to a few new and more sophisticated lines of argument." Alas, five years later, this still is not entirely true. Paluxy "mantrack" claims have been marginalized (but not eliminated), but fascination with dinosaur contemporaneity with humans continues to preoccupy many creationists. After all, it's hard to ignore museum displays of behemoth fossils—how do you explain to a child how these critters fit onto Noah's Ark, why they are all defunct, and how they fit into a young earth scenario at all? (I hold to a possibly unscientific view that children aged 3 to 9 have an inherent interest in dinosaurs, evolution, and science in general which is usually exterminated by their elders through inattention and outright opposition.) This issue's first two articles address some current creationist claims about dinosaurs. An extended book review continues the dinosaur theme.

Other authors address specific anti-evolutionist claims and/or analyze the phenomenon—*C/E* business more or less as usual—although the excerpt from a novel by Knight is a new wrinkle. A 1954 survey of students' science understanding was repeated recently on a new generation, and we publish it as a rarity—a follow-up useful for comparisons although the sample is flawed.

Oddly, no photos or figures accompany any of the current manuscripts. I hope to include art more liberally ("art" is the trade term for figures, photos, etc.) in the future, although photos, unless subsidized, will have to be scarce because of the cost of converting them to half-tone images. Line-drawn art is thus especially welcome.

Finally, a "commercial announcement:" NCSE operates on a shoestring budget and urgently needs subscription renewals and new members to stay alive—your help with both matters is important.

John R. Cole

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Creation/*Evolution*

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The journal of evolution and science education which explores aspects of evolution and antievolutionism

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Radiocarbon Dates for Dinosaur Bones?

Bradley T. Lepper

Prophesy upon these bones, and say unto them, O ye dry bones, hear the word of the Lord.

—Ezekiel

We have knocked 100 million years off the age of the dinosaurs.

—Hugh Miller

The Creation Research, Science Education Foundation (CRSEF) of Columbus, Ohio announced recently that several radiocarbon dates had been obtained on dinosaur bones which proved that "dinosaurs lived with man . . . as recently as 10,000 years ago" (Lafferty 1991:2A). The claim that dinosaurs co-existed with humans is a popular creationist notion supported by alleged human footprints found in rocks alongside fossilized dinosaur footprints (see Cole and Godfrey 1985 and Kuban 1989a and 1989b for an extensive discussion of this topic), prehistoric petroglyphs which creationists interpret as depictions of dinosaurs (Dahmer et al. 1990:372; Fields et al. 1990), and a few surprisingly recent radiocarbon dates obtained for apparent charcoal or carbonized wood supposedly associated with dinosaur bones (Bierle and Fields 1979; Morris 1984).

The special significance of the new dates reported by CRSEF, and presumably the justification for an article in the *Columbus Dispatch*, is that the objects which were dated are actual dinosaur fossils including specimens obtained from the paleontological collections of the Carnegie Museum of Natural History. Moreover, a "laser mass spectromitrist" [*sic*] from Russia's Moscow State University reportedly confirmed the relatively recent age of the specimens (Dahmer et al. 1990:372). These factors

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would appear to provide strong scientific support for creationist claims: authentic dinosaur fossils provided by a credible, even prestigious, institution are subjected to independent scientific tests which indicate an age 150 million years out of step with the accepted dinosaur chronology. This paper examines the evidence to see if the creationists' extraordinary claims are warranted.

CRSEF Dinosaur Research

The Creation Research, Science Education Foundation (CRSEF) is a non-profit, tax exempt corporation founded in Millersburg, Ohio in 1972 "to advance knowledge of the scientific evidences against evolution in schools and among the general public" (CRSEF n.d.). In addition to their search for traces of people and dinosaurs in the Cretaceous limestone of the Paluxy River area of Texas CRSEF researchers also are looking for Noah's Ark on Mt. Ararat in Turkey (CRSEF n.d.).

CRSEF obtained several fragments of fossilized dinosaur bone from the paleontological collections of the Carnegie Museum of Natural History "by disguising the nature of the creationist science group" (Lafferty 1991:2B) and by misrepresenting the nature of their proposed research. James King, Director of the Carnegie Museum, says Hugh Miller and his party identified themselves as chemists who wanted to do some analyses of the chemical composition of the fossils. King says that small "bits and pieces" which had spalled off the surfaces of various specimens were offered to Miller with the explicit warning that the fossil bones had been "covered heavily in shellac" and other "unknown preservatives." Miller accepted the fragments and indicated that the coatings posed no problems for the analyses they were considering. Subsequently, several of the bone fragments were submitted to the University of Arizona's Laboratory of Isotope Geochemistry for radiocarbon dating. CRSEF "also arranged the Arizona testing by not revealing its origins" (Lafferty 1991:2B). Austin Long, professor of geochemistry at the University of Arizona, informed Miller that there was no collagen (a protein which is the source of most of the carbon in bones) in the samples and that large amounts of shellac and other contaminants were present. Miller indicated that he wanted the samples dated regardless.

CRSEF's misrepresention of their intentions, although ethically questionable, may have been necessary in order for them to obtain the specimens they required. No responsible curator would have approved of sacrificing valuable dinosaur fossils for unsuitable tests. Radiocarbon dating techniques cannot date samples which are older than about 50,000 years. There simply is not enough carbon 14 remaining in the sample to measure reliably. It is a firmly established geological fact that dinosaurs lived between 248 and 65 million years ago. Indeed, the age of the rock layers which contained the

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fossil specimens CRSEF obtained from the Carnegie Museum has been established by numerous independent dating methods. These age determinations range from 130 to 150 million years before the present (Kowallis et al. 1991). Therefore, these fossils are outside the range of radiocarbon dating methods.

Creationists dispute the great age attributed to dinosaurs and, if they are correct, it might be possible to radiocarbon date dinosaur bones. But for the results to be credible the samples would have to be well-preserved organic matter from the dinosaur and free of any recent contamination:

> At a horizon of 40,000 years the amount of carbon 14 in a bone or a piece of charcoal can be truly minute: such a specimen may contain only a few thousand ^{14}C atoms. Consequently equally small quantities of modern carbon can severely skew the measurements. Contamination of this kind amounting to 1 percent of the carbon in a sample 25,000 years old would make it appear to be about 1,500 years younger than its actual age. Such contamination would, however, reduce the apparent age of a 60,000-year-old object by almost 50 percent. Clearly proper sample-decontamination procedures are of particular importance in the dating of very old artifacts (Hedges and Gowlett 1986:107).

It is clear that the samples obtained from the Carnegie Museum were not free from recent contamination and this fact alone should have precluded their use for dating purposes. But even if contamination wasn't a problem, is there well-preserved dinosaur organic matter in the fossils?

Dahmer and the other authors of the principal CRSEF research report claim that an "Analysis of the bones for 30 elements revealed no differences from modern bones with the exception of uranium and fluoride . . ." (1990:371–372). In other words, they claim that the bones are not permineralized and are in nearly pristine condition. It is not clear from the text exactly what dinosaur bones are being referred to here, but they cannot be the fossils obtained from the Carnegie Museum. At another point in the article Dahmer et al. (1990:371) state that "surface scrapings" from the fossils studied by CRSEF "contained from 1.9% to 7.4% carbon" (1990:371). Since bones generally contain about 12% carbon it is quite evident that these fossils are rather different from modern bones.

Dahmer and his co-authors do not present the results of their analyses in their article. However, Hugh Miller generously provided me with a copy of the elemental analysis of one of their dinosaur fossils. Daniel Fisher of the University of Michigan's Museum of Paleontology examined these results and concludes that there is nothing whatsoever extraordinary about them. The predominant suite of elements present and their relative percentages (including the 3.4% carbon!) are about what one would expect to find in hydroxyapatite and calcite, two of the commonest minerals present in ordi-

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Table 1
Radiocarbon Dates Attributed to Dinosaur Fossils and Associated Materials*

Date	Lab #	Specimen	Source
12,800	?	charcoal or tree limb	Bierle & Fields 1979 Fields et al. 1990
37,400 + 2950/- 2140	?	carbonized wood	Fields et al. 1990
38,000	?	carbonized wood	Morris 1984
39,000	?	carbonized wood	Morris 1984
39,500	?	dinosaur coprolite	Fields et al. 1990
45,920 + 5550/- 3250	?	"coalified wood"	Fields et al. 1990
23,760 ± 270	AA–5786	*Acrocanthosaurus* bone scrappings	Dahmer et al. 1990:373
25,750 ± 280	?	*Acrocanthosaurus* crushed bone	Dahmer et al. 1990:373
32,400 +	?	*Acrocanthosaurus* bone fragments	Fields et al. 1990
9,890 ± 60	A–5809	unidentified	Fields et al. 1990
16,120 ± 220	A–5810	*Allosaurus*	Fields et al. 1990
36,500 +	?	dinosaur bone	Fields et al. 1990

* Table compiled from Dahmer et al. (1990) and Fields et al. (1990). It is revealing that a complete list of all the radiocarbon dates does not occur in either source. The likely reason for this is that the three dates listed for the single *Acrocanthosaurus* specimen are not terribly close. The two closest are reported together in Dahmer et al. (1990), but even these dates are more than two standard deviations apart. The other more strikingly divergent date is reported in Fields et al. (1990) without mentioning the other two dates.

A noteworthy omission in both papers is the laboratory reference number which should be associated with each radiocarbon date. Laboratory numbers traditionally are considered standard information to be included with any publication of the relevant date. Neither Dahmer et al. (1990) nor Fields et al. (1990) indicate the laboratory numbers of any of their dates. Dahmer et al. (1990:373) suggest that this information was withheld in order to protect their sources, but representatives of several prominent radiocarbon laboratories (including the University of Arizona who provided two of thelaboratory numbers listed above) considered such protection unnecessary under any imaginable circumstances and universally decried the practice of publishing radiocarbon dates without their associated laboratory numbers. The laboratory number for the first *Acrocanthosaurus* specimen listed in Table 1 was provided by Hugh Miller. Miller claims that the identity of the other radiocarbon laboratory (or laboratories) is being kept secret because it is feared the lab will not continue to date additional samples if they find out the material is dinosaur fossils.

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Laser mass spectrometry dating is a very new and experimental technique. Its methods, assumptions, and limitations are not well understood. In fact, several geochemists I consulted had never even heard of laser mass spectrometry being used as a dating technique. One of the Russian researchers involved in the work is quoted in the *Columbus Dispatch* as admitting "This method is far from ideal. We're not sure of the absolute age." Dahmer et al. (1990) do not make this clear. Instead, they claim the laser mass spectrometry dates provide important verification of the radiocarbon dates:

> In any science, when a team of scientists is able to confirm one set of data by an entirely different technique, the chance of both being correct is better (Dahmer et al. 1990:372).

Until it is demonstrated to be a reliable and accurate dating technique laser mass spectrometry dating is of little value as a corroboration of the controversial ^{14}C dates. It is far more significant that the dubious laser mass spectrometry dates and the problematic radiocarbon dates are wildly inconsistent with the latest Rb-Sr, K-Ar, ^{40}Ar-^{39}Ar, and fission track dates for the strata which contain these dinosaurs (Kowallis et al. 1991).

Conclusions

In the past, creationists have attempted to discredit dating techniques based on radioactive decay, especially radiocarbon dating (e.g., Morris 1974:161–167). For an extensive review of creationist attacks on carbon-14 dating and answers to their arguments, see Weber (1982) as well as Strahler (1987:155–158). Although creationists generally have been willing to accept the validity of radiocarbon dates which do not exceed 3,000 years before the present, it is quite extraordinary for them to accept dates as early as those reported by CRSEF (see Table 1). Are some creationists now willing to concede that the earth may be as much as 46,000 years old? Referring to another dinosaur-associated sequence, one of the CRSEF research reports hints at an answer to this question:

> . . . because radiocarbon dating is more difficult to interpret beyond 5,000 years, we truly cannot say exactly when the Glen Rose strata was [*sic*] deposited (Fields et al. 1990:166).

In other words, they don't really believe dinosaurs could have lived as long ago as their dates indicate, but the dates are so much more recent than what evolutionists have claimed they should be they can be used to discredit the evolutionary position.

The papers by Dahmer et al. (1990) and Fields et al. (1990) work very hard at mimicking scientific reports, but they are pseudoscientific misap-

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Radiocarbon Dating Dinosaur Bone: More Pseudoscience from Creationists

Thomas W. Stafford Jr.

A tactic of creationists is to use apparently scientific methods and equipment to collect data supporting their theories. An outstanding example is using radiocarbon dating to show that humans and dinosaurs coexisted. Radiocarbon dating is a well established and accepted technique for measuring recent geologic ages. By ^{14}C dating dinosaur bones and obtaining apparent ages of less than 40,000 years, creationists believe they have used accepted scientific techniques and methods to prove that dinosaurs are thousands, not millions, of years old.

These "experiments" are also used to "prove" that the Earth is a few thousand, not billions, of years old, and that all life was created at once and without the assistance of evolution. For some, incontrovertible proof of human and dinosaur coexistencelies in newspaper comic strips or by watching a Godzilla movie on late-night TV. For others, additional proof is provided by scientific experiments that outwardly appear to be logical.

Creationists twist reality when they use radiocarbon dating to prove that dinosaurs and humans lived contemporaneously. After radiocarbon dating dinosaur bones and obtaining ages of less than 40,000 years, creationists use these data as evidence that the Mesozoic Era (Age of Reptiles) is (<40,000 years old, not 65 to 248 million years old, and that humans and dinosaurs lived together a few thousand years ago, thus negating evolution. Such creationism "science" may be theater of the absurd, but these one act travesties are reported without criticism in newspapers, and thereby gain a semblance of credibility. Like all rumors, they obtain a life of their own and

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become urban mythology. Combined with sufficient scientific jargon, the creationist "experiments" seem logical to an unsuspecting audience. The evil is that creationist dogma is being taken seriously enough by a scientifically illiterate populace that evolution is diluted or even omitted from *biology* textbooks. The result is that our education system is being made a travesty. While European and Asian nations accelerate past us intellectually, Americans are sliding back into the Stone Age.

The following discussion concerns the validity of using ^{14}C dating to support creationism dogma and why the scientific method is being corrupted by creationist followers.

Dahmer et al. (1990) state that ^{14}C ages of 16,000 to 25,000 years on dinosaur bones are proof that these fossils are millions of years younger than believed by paleontologists and that the dinosaurs must have coexisted with humans. The dating method used was conventional (beta-decay counting) and AMS (accelerator mass spectrometry) ^{14}C dating of dinosaur bone collected from the Carnegie Museum, Pennsylvania. A second report (Fields et al., 1990) presents ^{14}C results on carbonized wood, dinosaur bone, and coprolites from the Paluxy River site, Texas. These Texas ^{14}C dates ranged in age from 37,000 to 46,000 years on carbonized wood, to 39,000 years for dinosaur bone.

There are three fundamental errors in these experiments: (1) The radiocarbon dating method is not applicable for samples 50,000 years old, (2) The carbon isolated from the dinosaur bones had no chemical relationship to bone protein or flesh, and (3) The use of expensive chemical and physical tests and equipment, and learned testimonials is irrelevant to interpreting the data.

Age Dating Limits of Radiocarbon

Whether a sample is 100,000 or 100,000,000 years old, it will yield an apparent ^{14}C age of 40,000 to 45,000 years under the best circumstances. The term "greater than 45,000 years" means that the sample is no *younger* than 45,000 years. Its true age could be 46,000 years or a thousand times that value. The reason is that ^{14}C has a half-life of 5730 years, and after ten half-lives, the number of ^{14}C atoms is so small (2^{-10} of original) that the remaining ^{14}C atoms can not be detected accurately or distinguished from background amounts of ^{14}C atoms. Under these theoretical conditions, approximately 57,000 years is the limit for ^{14}C dating. The *practical* limit for ^{14}C dating is considerably less than the theoretical limit because a fossil is not sealed hermetically from the world after burial. The theoretical limit is lowered substantially because fossil charcoal, bone, and wood become contaminated with carbon from the environment. Foreign carbon is derived from ground waters, overlying sediments and soils, and by chemical and physical laboratory procedures used to prepare the sample for dating. The result is that about 40,000 years is an upper dating limit because minute

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amounts of modern carbon contamination severely change the age of very old samples (Hedges and Gowlett 1986). The addition of only 1% modern carbon to a 60,000 year old sample causes its age to decrease by almost half, to ~37,000 years. Because carbon samples for AMS ^{14}C dating customarily weigh one milligram (1000 micrograms), one percent modern carbon contamination in a 1 milligram represents 0.01 mg (10 micrograms) of carbon. Ten micrograms (10×10^{-6} grams) of modern carbon can be incorporated easily into a sample during routine chemical pretreatment even when using the best procedures in the best laboratories (Stafford et al., 1991; Verkouteren et al., 1987).

Radiocarbon laboratories routinely use Mesozoic coal, Precambrian graphite, and Paleozoic limestone and marble as infinitely old samples (in ^{14}C terms) to calibrate their instruments and evaluate chemical pretreatment methods. By ^{14}C dating coal or limestone, the laboratory determines the *^{14}C blank*. The blank is the amount of ^{14}C derived from geological and laboratory sources and includes modern carbon introduced during chemical pretreatment, combustion, purification of CO_2 in the vacuum lines, and during graphitization. Each process, no matter how well performed, will add a millionth of a gram (1 μg) of modern carbon. The cumulative effect is that five to twenty micrograms of modern carbon can be incorporated into the sample (Verkouteren et al., 1987). When ^{14}C researchers obtain ages of 55,000 to 45,000 years for coal or marble, they are measuring the cleanliness of their laboratory procedures. They are not establishing an age of 55,000 years for a rock known to be 100 million years old.

Another laboratory procedure uses graphite made from petroleum to test the chemical blank. Graphite without chemical pretreatment yields an apparent ^{14}C age of 57,200 years. Following chemical pretreatment with the same solvents used for fossil wood and charcoal samples, combustion, and re-graphitization, the sample "dates" as >49,000 yr. (Stafford et al. 1990:40). The lowering of the "age estimate" by 8000 years reflects the amount of modern carbon added during sample chemistry. The results are an example of the extreme difficulty in dating samples older than 45,000 years, and exemplifies the practical limits of the ^{14}C dating.

As a routine check of laboratory procedures in my laboratory, I routinely use fossil whale bone from northern Alaska. The well preserved fossil is >70,000 years old as established by uranium series dating and the fossil's geologic position in high elevation interglacial (Sangamon age) sediments (Stafford et al. 1987). The apparent ^{14}C age for this specimen was measured as 38,000 years (AA-312C) (Stafford et al. 1987). More recently, I have used fossil bone from a deeply stratified cave in France where Neanderthal human remains were present. These fossil bones were at least 50,000 years old, yet they yielded AMS ^{14}C ages of >42,400 yr (AA-2678) to >43,000 yr (AA-2679) (Stafford et al, 1990). These data are examples of the *practical* limit of ^{14}C dating, compared to the theoretical limit, which is at least 10,000 years

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greater. The ^{14}C ages of 38,000 and 39,000 yr on carbonized wood from the Taylor site (Fields et al. 1990) are the values expected and obtained routinely by ^{14}C laboratories that use geologically ancient carbon for measuring the ^{14}C blank. The results measure the amount of *modern carbon contamination* in geologically ancient carbon, *not an absolute age* for that wood.

As for the reliability of the two ^{14}C dating methods, conventional and AMS, accelerator mass spectrometry is not inherently more accurate than the conventional method of beta-decay counting (Hedges and Gowlett 1986). Accelerator mass spectrometry ^{14}C dating is widely believed to be more accurate than conventional (-counting) because AMS requires only 1 mg of carbon and the method costs two to three times more than a conventional ^{14}C date. In practice, the accuracy of a ^{14}C date depends upon the sample's chemical purity, which is related to its geologic history and chemical pretreatment before dating. Measuring the ^{14}C age by conventional or AMS methods indicates only how much carbon is used—one gram or one milligram. Dating a bone by AMS ^{14}C methods is no guarantee that the date is accurate. The chemical purity of the sample determines the accuracy of the ^{14}C date; what ^{14}C method is used has no affect on accuracy.

If a sample contains enough carbon for an AMS ^{14}C measurement, presently 100 micrograms of carbon, an age can be calculated from the data. Whether this number is an apparent or real age depends upon the geologic questions being asked. The ^{14}C method is limited to measuring ages for samples approximately 45,000 years old. By analogy, a thermometer whose lowest limit is 0° C (freezing point of water) will also measure zero for dry ice (-78° C) and liquid nitrogen (-196° C). The appropriate measurement technique must be used, whether for age dating or determining temperatures.

Chemical Composition of Modern and Fossil Bone

The Dahmer et al. (1990) report states emphatically that the ^{14}C dates were directly on dinosaur bone, not associated organic matter. The implication is that original bone protein, its decomposition products, or both, were dated. That the bone contained 1.9 to 3.5% carbon is irrelevant because the Leco combustion method measures *total* carbon, i.e., both organic and inorganic carbon. Curators at the Carnegie Museum and laboratory personnel at Arizona stated that the bone contained preservatives. Epoxies and shellacs are carbon-based preservatives and would have been the primary source of carbon for the ^{14}C date. Because *total* carbon was measured, the creationists ignored the presence of the substantial *inorganic* carbon component in bone. Carbonate (CO_3-2) is present naturally in bone apatite (carbonate-hydroxyapatite) as biological carbonate and $CaCO_3$ that is incorporated into the bone during burial. Bone with no measurable protein contains 2% carbon—all derived from inorganic carbonate.

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Nitrogen and quantitative amino acid analyses are definitive measurements for protein and amino acids (organic carbon) present in bone. Had these data been included in the Dahmer report, it would have been obvious that the dinosaur bones did not contain dateable amounts of proteins. Modern bone contains 4.5% nitrogen and 12 to 15% carbon depending how much lipid remains in addition to protein. Fossils with 2% carbon customarily contain 0.1 to 0.00% N. Even in severely degraded fossils with 0.1% N, much of this total nitrogen is ammonia (NH_4) and not amino acids. Consequently, the absolute test for protein content is using an amino acid analysis, which distinguishes between ammonia nitrogen and amino acid nitrogen.

Modern bone contains approximately 200 milligrams of protein per gram of bone. The primary protein in bone, collagen, has a characteristic amino acid composition and two unusual amino acids (hydroxyproline and hydroxylysine) that distinguish collagen from all other proteins. It is correct that amino acids and collagenous protein residues *have* been found in Mesozoic reptile (dinosaur) bones. (Armstrong et al, 1984; Wyckoff, 1972). Dating these bones by ^{14}C might signify that one could date the bone protein. Not mentioned is what *mass* of amino acids are present in dinosaur fossils, if any organic matter is present. Whereas modern bone contains 200 mg (200×10^{-3} g) amino acids per gram of bone, fossil bones of Pliocene through Jurassic age commonly contain 10 to 50 *micrograms* ($10 \text{ to } 50 \times 10^{-6}$ g) amino acids per gram of bone. Values of 100 to 300 micrograms/mg bone are known (Wyckoff, 1972:Table IX). The amino acid contents of the Cretaceous and Jurassic reptiles are 1000 to 20,000 times less than modern bone's protein content. Even using AMS ^{14}C dating, five grams of dinosaur bone containing 50 g amino acids per gram of bone would be needed to obtain the 100g of carbon for ^{14}C dating. Had this carbon contained only 1 g of modern carbon (1% contamination), the best age estimate would have been 37,000 years. Because proteins decompose with time, the preponderance of protein becomes soluble and is lost during preliminary dissolution of the bone. Commonly, one percent of the bone's measured amino acid content can be retrieved during chemical pretreatment. Consequently, one hundred times more bone, or 500 grams of bone would have been required if 100g of amino acid carbon were to be obtained.

Detecting amino acids is easy because the sensitivity of analytical instruments is high. Although picogram (10^{-12}) amounts of amino acids can be detected, the origin of these compounds is not established. Wyckoff believed that "Most [bones] have compositions suggesting they may be mixtures of collagenous and microorganismal proteins." (Wyckoff, 1972:82). AMS ^{14}C dating of individual amino acids isolated from an 11,000 yr old mammoth resulted in ages of 2000 to 4500 years (Stafford et al., 1990). The interpretation is that foreign amino acids predominate in leached fossil bones that have noncollagenous amino acid compositions. These results agree with the conclusion that severely leached bone contains substantial amounts of

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foreign amino acids. This scale of amino acid contamination would easily have resulted in the dates obtained by Dahmer, et al., 1990).

Dahmer et al. (1990) theorize that the black coloration of dinosaur bones is decomposed flesh. Reduced iron (Fe^{+2}) and MnO_2 predominate in fossil bones and are logical causes of black colors. Flesh and tendons have been preserved in Pleistocene fossils, but under permafrost or hyper-arid cave conditions that mummify the tissue and do not carbonize it. Animal skeletons preserved under anoxic conditions have well preserved bone that can be either white (Dansie et al. 1991) or stained black to reddish brown by tannins, manganese or iron. Decayed flesh is not preserved under these anoxic conditions. The logical source for the carbonaceous scrapings is the preservatives applied by museum technicians.

Evidence Through Obfuscation and Testimonials

Mimicking scientific methods and jargon does not guarantee logical interpretations of results. Repeating these creationist conclusions by college-educated scientists is equally sinister.

When Dahmer et al. (1990) use ultrasonication, acetic acid, methanol, and ultrapure water to pretreat their samples, they are obtaining well cleaned contaminants. They are cleaning shellac and other unidentified glues that are insoluble after they harden. Leco furnaces and Carlo-Erba analyzers will measure accurately the carbon content of any carbon bearing substance. These instruments will not establish the origin of this carbon. Parroting the techniques of chemists may convince creationists they are doing science, but the instruments will return analyses whether the samples were a silk purse or a cow's ear. A single amino acid analysis of the dated substance would have demonstrated the non-protein nature of their samples.

Equally misleading is the use of other exotic techniques to corroborate previous results. The use of multi-syllabic techniques that have no explanation is best suited for Star Trek movies. Laser mass spectroscopy, presented without its fundamentals established, has similar value. The Dahmer et al. (1990) report implies that this corroborating dating technique uses ratios of C, N, Ca, O, P and Cl to measure ages for bones. The method's physical principles are not stated, but the method seems to combine an old idea with new measurement technology. Oakley (1963) suggested that percentages of fluoride, uranium and nitrogen in bone could be used for relative dating. The technique was termed FUN dating, after the three elements involved, and was based on his observation that with increasing age, bone contained less nitrogen and more uranium and fluoride than modern samples. Laser mass spectrometry is a method for determining elemental analyses on very small samples. Carbon and nitrogen both decrease in bone because protein decays and its amino acids are lost to the environment. Uranium and fluoride are added secondarily to bone and are derived from groundwaters and enclosing

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sediments. A bone's geologic age can be estimated *in orders of magnitude* by using N content; these data are used to rank fossils as well, moderately and poorly preserved (Stafford et al. 1988) and can, at a given locality, be used to distinguish samples a few hundred years old from those several thousands of years old. The method is relative, not absolute, and the results are confused by differences in local depositional environments and geohydrology.

The most insidious technique used by creationists is having college educated people recite and defend conclusions that are absurd at best. Sometimes known as the halo effect (Lastrucci 1986), these testimonials by biologists, chemists and engineers, among other disciplines (or is it disciples?), are attempts to validate creationist dogma by association with "physical or natural scientists." The creationists ignore the fact that any person can learn and regurgitate descriptive scientific terms. The laws of physics and mathematics apply equally to falling apples and rockets, and are unchanged whether you believe the apple is the product of evolution or the fruit of God's Hand. A creationist geologist describing a physical event in nature is proof that a person can record natural phenomena. If he is unable to interpret the data logically, it is detrimental to the person, not the field of geology. A geologist believing in creationism is no more germane or detrimental to evolutionary theory than is our entire legislative system compromised by one of its members being a Ku Klux Klan member.

In conclusion, the errors in creationist arguments are due to their total ignorance of chemistry and the principles of physics, the misapplication of these fields, and the use of purported scientific techniques to prove their dogmas. There are well known and valid ways to analyze for proteins and these techniques are ignored. The technique of radiocarbon dating is indeed well established and valid. However, ^{14}C dating is no more able to distinguish between 100,000 yr and 100,000,000 yr old samples than is a truck weighing scale capable of detecting an extra speck of dust in a 10,000 pound cargo. It is a travesty of physics to apply ^{14}C dating to samples millions of years old.

Finally, mimicking scientific methods and vocabulary is used to simulate scientific inquiry. If different experimenters obtain the same results, either a major discovery has been confirmed or everyone has made the same fundamental error. The fundamentalists err by assuming they are correct if their fellow believers see the same result. They are as correct as all those who joined in their praise of The Emperor's New Clothes.

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Science or Animism?

Bruce Stewart

In 1954, the old *Scientific Monthly* reported a survey of students, who had just completed an introductory college biology course, on the subject of animistic beliefs concerning the nature of life. Since I participated in that survey, I wondered what change had occurred 35 years later. I therefore arranged in 1989 to have the same survey questions given to an introductory biology class (of 100 students) at Michigan State University from which I retired.

As the following data show, the animistic responses doubled and tripled, not decreasing in any instance.

This result could be questioned as an atypical sample, but the only way to ascertain this is to repeat the survey elsewhere. I don't know whether there is any interest, but this kind of biological nonsense should be checked, and if present, efforts made to counteract it.

Scientific authorities have expressed belief that such mythology exists to an alarming extent, for example, Heinz Pagels, late director of the New York Academy of Sciences, said in his book *The Dreams of Reason*, "According to some pollsters, about 70% of all U.S. college undergraduates believe in some kind of psychic or supernatural forces lying outside of natural science." He argued that this is because the students were brought up on the fare of TV and scientifically irresponsible books and magazines, and "unfortunately there is no way for empirical science to compete with the excitement offered by occult 'science.' "

Is he right? Let us hope not.

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The Survey Results, 1954 and 1989

		1954 %	1989 %
1.	Many ships are lost at the bottom of the sea. We cannot find them. Do you think the sea itself knows where they are?		
	A. Yes, because the chemicals of the sea come into contact with them and know where they are.	0	16
	B. Yes, because the sea rubs over them and knows them to be there.	0	5
	C. Probably not because the sea has no nerves of its own.	13	17
	D. No, there are so many sunken ships, the sea could not keep track of them all.	0	0
	E. No, the sea is incapable of knowing anything.	88	62
2.	When an automobile tire blows out, does the tire feel anything?		
	A. Yes, the tire feels the great and sudden reduction of internal pressure.	0	6
	B. Yes, the rubber molecules are very active and feel the rending and tearing.	8	8
	C. Probably not, the rubber in the tire has been dead for a long time since it was part of a tree.	3	12
	D. No. Once a tire blows out it is too dead to feel.	0	1
	E. No. An automobile tire cannot feel anything.	90	73
3.	When a plant is cut off, it wilts. Does the plant feel depressed when this happens to it?		
	A. Yes, its gradual reduction of living force makes the plant suffer.	3	14
	B. Yes. The cells shrink and become dry and cause a depressed feeling.	3	8
	C. Probably, but only in a very dim sort of way.	8	11
	D. Probably not. Plants to not have consciousness, at least to this degree.	30	41
	E. No. Such feelings are not possible for plants.	57	24
4.	Is the sun in any way living?		
	A. Yes, because it gives off flames which indicate life.	0	3
	B. Yes, because it gives forth energy which makes life possible on earth.	0	23
	C. Yes, it is not breathing, but it is pulsating, ever-changing and therefore living.	11	17
	D. Probably not. It is doubtful that the sun shows any manifestations of life.	15	26
	E. No. It is not in any way alive.	75	30
5.	The natural oyster pearl was once in a shell in the sea. When the water moved over it could the pearl feel the movement?		
	A. Yes. It was a growing thing, much like a fetus in the mothers womb.	0	6
	B. Yes. The pearl was part of a living thing.	0	6
	C. Probably, but only indirectly through the senses of the oyster.	5	14
	D. Probably not. A pearl is just a kind of growth like a tumor.	45	37
	E. No. A pearl could never feel anything.	50	35

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Science at "Bob Thurston University"

Kathryn Lasky Knight

Ed:The mystery novel Mortal Words concerns the detective work of Calista Jacobs and her teen-age son Charley. As part of a complicated murder plot involving televangelists and "scientific" creationists, the sleuths visit a fictional Texas college famous for its "scientific" creation advocacy. Charley has applied for admission as a ruse to gain an interview where the following scene takes place. The book is fictional.
Charley speaks first to an administrator:

"I'm really interested in your creation science program here."

"Oh, now you're talking." [Tommy Lee] Clayton pointed his finger directly at Charley. "We're really blowing some of these other so-called scientists off the map. We got some outstanding research going on down here and some real new breakthroughs which you'll be reading about in the not-too-distant future. You be sure to have Beth Ann give you a complete tour of our Williams Jennings Bryan Creation Science Center. We've got some excellent young professors on board."

"Yes," Charley nodded. "I've been reading about this man Fernald."

"Ah, yes, Gerald Fernald. He'll be coming to teach here next fall."

"Yes, I've been reading about his theory of the vapor canopy that shielded the lower atmosphere from cosmic radiation and why that means that radiocarbon dating isn't really accurate."

"Well, my goodness, son, you are up on things."

"Yes, sir. And I'm trying to plan an experiment for the Westinghouse Science Fair that, well . . . you know," Charley squirmed and gave a very good imitation of bashfulness. "I mean, I can't prove conclusively . . . "

Kathryn Lasky Knight is an award-winning author of many children's books and a series of mystery novels featuring the heroine, Calista Jacobs. This excerpt is reprinted with her permission from *Mortal Words*, Pocket Books, 1991 (copyright Knight 1990).

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"Yes, son, yes!" Tommy Lee was leaning forward, his elbows on his desk, eagerly awaiting Charley's words.

"Well, I think there's a way that you can prove the water shield theory and the specific reduction of radioactive carbon if you start using amber samples."

"Amber? Well, I'll be."

"Yeah, you see, amber really keeps all those precipitates intact that come from the atmosphere . . . " Charley was off and running with his theory of amber precipitates as an index of an antediluvian vapor canopy. It was total gobbledygook. He was talking Iridium and Zinc indices and atmospheric scrubbing particles that could be evidence of a great deluge four thousand years ago. It was a bizarre mixture of chemistry and particle physics and Scripture. Light on the Scripture. He apparently had only read the creation part.

"And what happens if it doesn't turn out right?"

"Right?" Charley looked bewildered. Calista felt totally disoriented. Had such a question really ever been asked in such a way about scientific inquiry? "You mean if the experiment I do for the Westinghouse thing shows that there couldn't be a vapor canopy that would interfere with radiocarbon dating?"

"Yeah." Clayton's voice was flat. This was a trap. Shit!, Calista thought. Why did Charley have to go mouthing off about this? Why couldn't he have come here like any other admissions candidate? When was the last time they had one in this office who had aspirations for a Westinghouse Science Award?

"Well . . . ," Charley paused. "It will be the wrong experiment."

Suddenly Calista saw what Charley was doing. "Right," she said. "No need to throw out the baby with the bathwater—or the Flood waters." She smiled weakly. At this, a huge grin cracked Tommy Lee's simple face. What a pair of phrasemakers they must appear to be, Calista thought . . .

"Yes," said Charley, picking up on his mother's line. "You don't throw out the Scriptures. I must just be misunderstanding them in some way, and so I'll have to come up with a new experiment."

Tommy Lee smiled again. Calista breathed a sigh of relief. They had played the game right. Any model of a Biblical deluge can be falsified, but the truth of the fact of the Flood cannot be. Models and experiments can be shoved and nudged, but not Genesis. C/E

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Evolution's Hidden Agenda—Revealed!

Arthur Shapiro

Just what image do convinced creationists have of evolutionary biologists? Are we simply deluded? Are we demonically possessed? Are we willing agents of Satan? Are we just fools? The Institute for Creation Research, or at least its Administrative Vice-President, John Morris, apparently has discovered the truth about us. Not only that, they've broadcast it in print to their regular subscribers.

One of ICR's regular monthly pamphlet series, sent out to the Institute mailing list, is called "Back to Genesis." Issue #20, dated August 1990, contains an article by John Morris entitled "Why Do We Marry?"—an interesting question, but not what the article is really about, namely the contention that evolutionary biologists carry out research in order to support a program of subverting the traditional, nuclear family *on purpose*. "What is not so apparent from the news media seen by most people, is that the underlying impetus for this anti-marriage/family movement comes directly from the evolutionary sciences. Few laymen may know it, but the technical evolutionary journals frequently feature articles which describe how modern society should be shaped" (Morris, 1990). Morris then goes on to catalogue a variety of social phenomena observed in non-human species (infanticide, promiscuity, homosexuality, euthanasia) and describes the conclusions we draw from such observations: "we should pattern ourselves and our culture after these animal groups. Only the kind of behavior which brought us to this evolutionary stage will be able to carry us onward to higher levels of evolutionary development."

The absurdity of such a conclusion is evident. But even more troubling than the illogic in what is represented as our position is the claim that the aim of evolutionary studies of animal behavior is *normative*. Although sociobiologists are notoriously susceptible to the temptation to blather about human society—and have often been caricatured for that reason—I

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could not recall *ever* seeing an article in the "technical evolutionary journals" which argued in such a way, and I could not imagine one getting in (at least since the 1930s). The "technical evolutionary journals," after all, are not advocacy venues like ICR's publications! So I wrote to Morris on 1 August 1990:

> I thought I had a pretty good handle on the professional literature of my field. . . . Now I'm not so sure. . . . I must confess that I cannot recall ever having seen a single article that remotely resembled your description. Do you see why I am perplexed? Am I reading the wrong "technical evolutionary journals? . . . Over the years I have often had one-time, *ad hoc* seminars on topics of special interest. . . . If you can send me a bibliography of truly relevant and reasonable recent articles of the sort you describe, I will have a seminar on—shall we call it "Normative Evolutionary Biology?"—at which I expect we will tear such stuff to ribbons. . . . What I am asking for is a list of, say, at least ten relevant articles from the "technical evolutionary journals," published within the last 10 (or if necessary, as much as 25) years . . . You say they appear *frequently*, so it should not be hard to generate such a list. . . . Over the years I have said some fairly nasty things about creationist scholarship, but as a fair man I am delighted to have the opportunity to be taught something about the literature of my own field by a creationist. I eagerly look forward to a prompt reply.

I didn't get a reply.
So on 22 August I wrote again.

> The time is rapidly approaching when I must have your reply . . . if I am to make use of it in teaching this Fall Quarter. . . . I am still eagerly awaiting your response, conscious as I am that philosophical differences should be no barrier to communication between scientists—or gentlemen.

I enclosed a clipping from the *San Francisco Chronicle* about recent research on animal breeding behavior, which listed many prominent evolutionary behaviorists—adding that "perhaps the list of names mentioned here will help you to locate the articles your refer to" in the *Back to Genesis* piece.

Again I heard nothing, and no seminar was scheduled.
On October 10 I gave Morris both barrels.

> Your failure to respond to my good-faith letters of 1 and 22 August . . . speaks volumes. If you had any references to back up your claim, you would have sent them. You do not, because there aren't any.

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> You calmly, systematically libeled an entire profession by telling a naive readership, one which does not know "the technical evolutionary journals" from a cantaloupe, that evolutionary biologists routinely extrapolate from animal behavior to an advocacy position on the "shaping of human society." That is an outright lie.
>
> You purport to be a Christian and a defender of traditional values. Yet you have violated one of the Ten Commandments by deliberately bearing false witness. Do you think the Lord Jesus Christ approves of libel?
>
> Your conduct in this matter is an affront to anyone, Christian or not, creationist or evolutionist, who believes that debate should be grounded in *truth*. . . . You owe everyone a retraction of the false claim in "Why Do We Marry?" and if it is not forthcoming, you deserve the widest possible exposure of your unethical behavior; *and you will get it.*

On October 19 I received a letter from one Mary Thomas, Administrative Assistant to John Morris, informing me that *she* had seen no previous communications from me but that she would call *this* one to his attention when he returned from overseas in mid-November.

And she did, as I received a single-spaced, two-page letter from John Morris himself. (I would love to print this letter in full, but Morris denied me permission to do so in a letter dated February 4, 1991.) Morris begins by apologizing for the delay in answering my various letters, pleading a busy schedule. He says he is somewhat confused by my reaction to his article; after all, the evolutionary literature does extrapolate from animals to humans "as is indicated by these several enclosed reprints" (more on these shortly; of course, no one denies such extrapolation—it's *normative* extrapolation that's at issue). But, he says, they (evolutionists) don't "spend a great deal of time engaging in this practice." He then wanders around in a long paragraph about "the evolutionary literature," before getting to the point on the second page.

"What I intended to imply (although I would say it differently now that you have pointed out to me less than totally accurate implications) is that the evolutionary literature which they are prone to read . . . makes implications on human behavior based on animal studies." Once again, extrapolation is confounded with normative judgment. "They" here refers to the lay audience of *Back to Genesis*. He then lists *National Geographic*, *Natural History*, *Omni*, and "even newspaper articles" as the "evolutionary literature" he has in mind. (He missed the *National Enquirer* and *Weekly World News*!) So much for the "technical evolutionary journals." Indeed, Morris' *point* is that the popular media, willingly or otherwise, *conceal* from the public the sinister role of the "evolutionary sciences" in undermining marriage and the family—and if only the public could see what we read professionally, they would know the truth.

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After defending his personal role as an ethics enforcer within the creationist movement—helping to curb the excesses of some of his less rigorous brethren—Morris ends thus: "To sum up, I regret having used the term 'technical evolutionary journals' to which you reacted. I should have used a less specific term such as 'the evolutionary literature.' I trust this clears up any misunderstanding."

Try it; substitute this term in the original sentence. "Few laymen may know it, but the evolutionary literature frequently features articles which describe how modern society should be shaped." Does that clear up any misunderstanding?

On 26 November I wrote an emotionally neutral letter thanking Morris for his explanation and proposing that the entire correspondence be published in the interest of improved communication, in a mutually agreeable venue. Morris did not reply. On 7 December he visited the campus under the sponsorship of a local Christian center and gave a public talk, which I attended. I sat near the front and Morris knows me, but he did not acknowledge me or make any attempt to contact me although he was in town three days. On 10 January I wrote to jog his memory about my publication proposal. Most of the letter was about end-time eschatology and the Persian Gulf crisis, a ploy intended to coax an answer out of him. It worked; the result was the 4 February letter declining my suggestion to publish.

Needless to say, no explanation, retraction, correction or apology ever appeared in *Back to Genesis*.

Now about those enclosures. They represent Morris' only effort to document his assertions about our motives, so they should tell us something about his understanding of how science and "the literature" work—and perhaps about his ability to read and interpret the English language. So what are they?

One is an article from the May issue of *Science 84*: "Infanticide: Why does it happen in monkeys, mice and men?" by Barbara Burke. The article is largely based on the work of primatologist-anthropologist Sarah Blaffer Hrdy. The article indeed compares non-human and human behavior, but far from prescribing that humans emulate non-humans and commit infanticide more frequently, it advocates using comparative, interspecific approaches in order to better understand *and prevent* child abuse and infanticide in human beings.

The other is a photocopy of several pages from the book *Culture and the Evolutionary Process*, by Robert Boyd and Peter J. Richerson, which Morris annotated in the margin "Just a sample of documentation." Consisting of part (pp. 276-307) of the chapter "Indirect Bias and the Evolution of Symbolic Traits," this is a discussion of functionalist vs. non-functionalist interpretations of culturally determined behaviors. The following paragraph is flagged by Morris:

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> In its most extreme version, this hypothesis would invert the usual sociobiological interpretation of prestige. Irons (1976), Dickemann (1979), and others have argued that the fact that in many societies prestigious males are also polygynous is strong confirmation of the hypothesis that cultural traits enhance genetic fitness. However, if prestige is accorded mainly for group functional behavior, then it is possible that group selection acting on cultural variation has favored patterns of mating that act to increase the frequency of genes which increase the success of the group but would reduce individual fitness in the absence of the culturally acquired mate preference. Throughout this book, we have assumed that genetically transmitted biases could act to shape the direction of cultural evolution. Cultural traits which affect mating preference could similarly affect genetic evolution through the action of sexual selection. In effect, the human genome could be "domesticated" by culturally transmitted traits. Much as a prize bull has high genetic fitness because he contributes to a farmer's profit, a prestigious figure may be allowed extra opportunities to reproduce because his genotype produces individuals that tend to be active on behalf of their culture.

This, of course, is all arm-waving. It is difficult to see Morris' claim of an anti-family agenda documented in this passage unless he read all the "coulds" and "mays"—the signature of arm-waving in such literature—as *prescriptive*. Even then, the implications for traditional values are unclear. Does Morris think evolutionary biologists advocate politicians and entertainment and sports figures actually *impregnating* their groupies? Is Wilt Chamberlain's sex life a result of reading *Behavioral Ecology and Sociobiology*?

Sarah Hrdy, Robert Boyd and Peter Richerson all happen to be colleagues of mine at Davis, a fact certainly unknown to John Morris. (The 1984 article says Sarah is at Harvard.) I can personally vouch for the fact that none of them is a red-eyed, drooling agent of Satan. And after seeing John Morris' idea of "documentation" of his preposterous allegations, I feel much better; I just don't think I have been reading the wrong "technical evolutionary journals" all these years, or been a dupe for dark forces bent on destroying the nuclear family.

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Life—How It Got Here: A Critique of a View from the Jehovah's Witnesses

Malcolm P. Levin

I learned a very important lesson that night. People believe whatever they read. Something magical happens once it's put down on paper. They figure no one would go the trouble of writing it down if it wasn't the truth. Responsibility was my new watchword.

—Jerome, in *Biloxi Blues*, by Neil Simon, 1986, p.79

Life—How Did It Get Here? By Evolution or by Creation? (Watch Tower Bible and Tract Society of Pennsylvania, International Bible Students Association, 1985) replaces an older version of the book produced by the Jehovah's Witnesses. According to The Society, this book, published in 16 languages with 11 million copies in print, is for those people who "are uncertain what to believe," and the book "presents a thoroughly researched examination of how life got here—and what it means for the future" (*Life*, 1985, p. 4). In the context of its widespread readership, of its claims of offering insights into truth and of its claims of knowability regarding the origin of life, we review this book. Thousands of Witnesses canvas America daily—far more pervasively than creation-science evangelicals.

Because there are significant parallels between this and other creationists' books, we compare some aspects of the Jehovah's Witnesses' book with one prominent example, the Institute for Creations Research's *Scientific Creationism* (Morris, 1985). Morris' book has already been criticized extensively by others—for example, Futuyma (1983), Kitcher (1982) and Wilson (1983). These criticisms fault the creationists' approach to the nature of science, especially what constitutes proof in science. The text under review

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is no exception in this regard; it follows a nearly identical pattern of reasoning. Moreover, the extensive use of flawed logic to make deductions and inferences about scientific truths exhibits striking similarities to *Scientific Creationism* and other creationist writings. Other important features of The Society's book include a failure to distinguish among the differences in ways of knowing with respect to science (p.10) and religion, and a unique and highly restrictive definition of science (p.50). Lastly, *Life* (1985,p.10) raises the question of fairness—if creation is not scientific, should one not also ask: "Is evolution truly scientific?"

Major differences also exist between this book and *Scientific Creationism.* In addition to the liberal use of Biblical exegesis within the Jehovah's Witnesses' publication that is not a part of the Morris book (Public School Edition), differences in theological and exegetic interpretations are also apparent. Further, the anonymous author or authors (hereafter referred to in the singular) of this book not only quote out of context but also fail to show the reader that words, phrases and clauses have been omitted from quotations. We also address these points below.

Kitcher (1982, p.30 ff.) has extensively criticized the nature of science expounded by Morris and other creationists. In particular, he argues that the nature of proof required by creationists to verify evolutionary theories, or for the proof of scientific theories in general, would effectively prevent science from gaining insights into the natural world. Demands imposed by The Society with respect to proof in evolutionary biology include the verification of spontaneous generation in the laboratory (p.17 ff., 38 ff., and p. 50 ff.); the documentation of a fossil history dating back to the first billion years (p.60); empirical evidence for new "kinds," speciation, by means of point mutations (for examples see pp. 103, 107, and 110); and the elimination of gaps in the fossil record, especially with regard to human evolution (p. 84). In this context, we also note The Society's definition of evolution: "as used in this book, [evolution] refers to organic evolution—the theory that the first living organism developed from nonliving matter" (p. 10). Thus, given the criteria for proof established by The Society and its definition of evolution, it is clear at the outset that The Society's view of is incompatible with all aspects of evolutionary theory and much of science in general.

The criticisms espoused by The Society concerning spontaneous generation (p.38) and the lack of an early fossil record lead to a rejection of the scientific proposition of initial life from non-life; spontaneous generation is labeled impossible. Moreover, the burst of life in the Cambrian following little or no fossil evidence from the Precambrian [according to The Society], points to a sudden creation and to a creator. In arguing its position The Society quotes liberally from two popular science books, *Red Giants and White Dwarfs* (Jastrow, 1979) and *The Enchanted Loom* (Jastrow, 1981). Jastrow, an astrophysicist, is repeatedly quoted out

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of context (e.g. *Life*, p. 53). Any reader with even a cursory knowledge of Jastrow's writings knows that he is providing a popular version of the history of the universe and of evolution of life on earth. However, a novice of science would surely conclude that Jastrow, as quoted by The Society, rejects biological evolution at the very least and that the "Superb organization [of the universe] requires a superb organizer" (*Life*, 1985, p. 123). Thus, The Society leads the reader to believe that the evidence is inadequate and that recognized scientists reject the facts of evolution. For a parallel interpretation, see Morris (1985, p.70).

Two additional points need to be made. First, The Society has espoused the "hypothesis,"—and consistently argues—that the order found in the universe and in life requires an intelligent designer. The argument from design is an often used ploy of "scientific" creationists and other fundamentalists of the religious right in their efforts to dismiss evolutionary theories (Kitcher, 1982, p. 135 ff.). However, this method of reasoning shows the same inherent weaknesses that were exhibited in 1802 when proposed by Bishop William Paley in his book *Natural Theology*. While we might excuse Paley in his time, The Society should not expect such logic to be accepted as a credible argument today. Hume had already disposed of the flawed watchmaker analogy in his *Dialogues Concerning Natural Religion* (1779). In short, the proposition relies on sloppy logic and is non-scientific because it proposes supernatural explanations.

Secondly, with respect to the lack of early fossils, The Society again uses flawed logic. It argues, as a major premise, that evolution predicts a fossil record proceeding from non-life to life and from simple forms—proto-cells are implied—to complex cells as they appear in the late Precambrian. As a minor premise, they state that the fossil record fails to show such life forms. The faulty conclusion that follows is that there must have been a creator for this wonderful universe. Not only is the conclusion unwarranted logically and scientifically, but the major premise is clearly not a hypothesis proposed by evolutionary biologists or paleontologists, nor is it expected given the nature of the fossilization process and the fossil record.

Flawed logic is also presented in The Society's discussion of transitional life forms in the fossil record. "If evolution were a fact, surely in all of this [the fossils already discovered] there should be ample evidence of one kind of living thing evolving into another kind" (*Life*, p.19). Eldredge (p. 21), Raup (p.20) and Stanley (p.21) are quoted to support the supposed lack of transitional forms. The implication is that none exist. Several chapters later (p.55 ff), the reader is presented with a table and a "logical" argument of the following form:

1. Evolutionary theory predicts that "many transitional 'links' between different kinds" (p.55) existed.

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2. An examination of the fossil record, according to noted evolutionists, fails to produce such transitional forms.
3. Therefore, there must have been a creation and a creator.

This example also illustrates The Society's failure to distinguish among ways of knowing in science and in religion. Not only does The Society limit science to its narrow definition—the scientific method, experimental and empirically verifiable—but it also employs false, illogical deductions with properties that are at best philosophical and characteristically religious. Where science does not have the answers, according to The Society's definitions, the author invokes his version of religious truth. The writer of this book, either through a lack of understanding of science or through purposeful misrepresentation of it, mixes ideas whose properties are characteristic of religious dogma with those of science. The writer would do well to read Gilkey (1985, p. 98 ff) or Barbour (1966) for thoughtful explanations of the nature of religion and an introductory text in logic for methods in syllogism construction.

The question of fairness with respect to the treatment of the truth of evolution and of creation is raised in both this book (p.10) and in *Scientific Creationism* (Morris, 1985, pp.4 ff and 8 ff.). However, in contrast to Morris, The Society refrains from making the claim that both theories are equally unprovable. Neither does it appeal to the reader for an equal treatment of the two "models" (Morris, 1985, p. 3). Rather, throughout the book, especially chapters 17 and 18, The Society argues the truth of the Bible and hence the truth of creation. Since The Society does not seem to be concerned with the problem of making its book potentially acceptable to public education in the formal sense, the writer makes no effort to refrain from mixing his theology and biblical exegesis with his alleged scientific arguments. Thus, one could describe the general form of the book as "scientific" theology—the structure and function of the natural world are so awesome and amazing that a designer is the only logical explanation.

Moreover, an examination of the Jehovah's Witnesses' theology and dogma also reveals why other striking differences are found in The Society's book when compared to the writings of creationists, especially those of the Morris ilk. Toumey (1987) describes Jehovah's Witnesses as apocalyptic separatists. One of the important features Toumey identifies in their theology is a cosmological view that "focuses on a great primal struggle between God and Satan, soon to be concluded in an Apocalypse, in which humans are relatively insignificant" (Toumey, 1987). This cosmogony, in conjunction with the Witnesses' opposition to evolution, leads the author to conclude that "the theory of evolution serves the purposes of Satan" and that the purpose of the "doctrine of evolution . . . is to defraud us of eternal life" (*Life*, p.248). This statement stands in sharp contrast to *Scientific Creationism* in which the only discussion of Satan is in Morris'

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rejection of the Gap Theory as an explanation for the pattern of the fossil record (Morris, 1985, p.231)

A second important feature of Jehovah's Witnesses' beliefs is the view that all of the world, outside of their religion, is satanic (Toumey, 1987). Hence, they must remain doctrinally separated from other religions. This separation demands an interpretation of creation with a unique dogma—the days of creation are "precise units of time, 7,000 human years each" (Toumey, 1987, p. 240). While the author (Life, 1985, pp. 26-27) does not make this aspect of the Witnesses' doctrine explicit in this book, he is clear in his rejection of the literal 24 hour day based upon an exegesis of Psalms (90:4) and 2nd Peter (3:8)—a day is like a thousand years. Thus, the 24 hour day, a cornerstone of Morris' "scientific" creationism, has no place in the Witnesses' cosmogony.

One additional distinction between The Society's book and *Scientific Creationism* is worthy of criticism. As noted above we find that quotations from scholars in the various scientific disciplines are routinely taken out of context. The result is that scientists such as Eldredge, Gould, Jastrow, Johanson, Mayr, Ruse, Stanley, and Wald, to name a few, appeal to the naive reader to reject all aspects of evolutionary theory. The pattern of treatment is like that of Morris; however, The Society goes one step further. It is not unusual for words or phrases to be omitted without the use of ellipses to indicate such changes.

For example, the author, in a discussion of the appearance of our hominid ancestors, quotes from *Lucy* (Johanson and Edey, 1981) as follows: " 'No one can be sure just what any extinct hominid looked like' " (*Life*, 1985, p.89). The quotation stands as if the full sentence was cited. In the context in which the quotation is used, the objective is to persuade the reader that paleoanthropologists have no basis for describing any physical features of early hominids. The author mixes statements about artists' liberties in their choice of the skin and hair of early hominids with statements about fossil remains. Johanson and Edey (1981, p. 286) were precise in what they intended to communicate: "No one can be sure just what any extinct hominid looked like with its skin and hair on. Sizes here are to scale, with *afarensis* about two feet shorter than the average modern human being." These statements are part of an explanation of a figure showing a proposed hominid family tree—not a declaration of ignorance about hominid features.

A second example is found on pages 68 and 69 wherein several "authorities" are quoted concerning the alleged lack of transitional forms in the fossil record. In the section on reptiles becoming birds, the author quotes Stebbins (1971) p. 146: "The transition from reptiles to birds is more poorly documented" (*Life*, 1985). "More poorly" than what, one might ask. In fact the full quotation is as follows: "The transition from reptiles to birds is more poorly documented than are the other transitions between classes of ver-

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tebrates." Stebbins had spent several previous pages explaining that these other transitions are quite well understood. (It is interesting, but not surprising, to note that the author failed to use Stebbins as an authority for the other transitions, opting instead to quote from a number of books published by Time-Life in the early '60s and now out of print—hardly the substance of a "thoroughly researched examination." We also note that the quote is from the 2nd edition of Stebbins. His 3rd edition has been available since 1977; the quote is on page 217 (Stebbins, 1977).

We have examined what we believe to be many of the important defects of this creationist book. Other examples illustrating the alleged failure of mutations to be beneficial, the claim that laws of probability preclude the possibility of evolution, and the mistaken belief that evolution is not testable could have been addressed. The list is nearly infinite. In no way can this book be regarded as scientific. Like Morris' *Scientific Creationism*, it is simply one more book of pseudoscientific nonsense that biologists and other scientists must constantly refute. When we reflect on the time invested in such refutations, we can only hope that the effort has improved our wit, strengthened our resolve to think critically, and improved our ability to convey the meanings of science and evolution.

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Reviews

Darwiniana

Compiled by Gareth Nelson;
Additional material by J. Cole

Darwin biography is a growth industry. Just *some* of the recent titles are listed here. Books vary in quality and focus (some stress intellectual history or science history, for example, while others are more strictly biographical), and it would be impossible, or at least mind-numbing, to read all of these diverse efforts to cover the same or similar ground. Desmond and Desmond and Moore are especially recommended, although each may have something to offer the serious researcher.

Historical material such as Darwin's papers and letters have been sorted and published in recent years, feeding biography fever; readers are urged to consult these original sources as well as works Darwin *intentionally* published, which are copious, brilliant, elegant, and too-seldom actually read.

*Bowlby, J. 1991. *Charles Darwin: A New Life*. NY: W.W. Norton. xiv+511 pp. $24.95

Bowler, P.J. 1984. *Evolution: The History of an Idea*. Berkeley: University of California Press.

Bowler, P.J. 1990. *Charles Darwin: The Man and His Influence*. Oxford and Cambridge, MA: Basil Blackwell. xii+250 pp. $21.95

*Desmond, A. 1989. *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London*. Chicago: University of Chicago Press. x+503 pp. $34.95 ("Please read this book.")

*Desmond, A. and J. Moore. 1992. *Darwin*. NY: Warner. 832 pp. $35.00 ("read this" and forget the rest, if you have to choose.)

Foncaldi, G. 1991. *Darwin in Italy: Science across Cultural Frontiers*. Bloomington: Indiana University Press.

Hodges, M.J.S. 1991. *Origins and Species: A Study of the Historical Sources of Darwinism and the Contexts of Some Other Accounts of Organic Diversity from Plato and Aristotle on*. NY: Garland.

Godfrey, Laurie R. (Ed.) 1984. *What Darwin Began*. Boston: Alwyn and Bacon (Non-Darwinian evolutionary theory today.)

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* Most recommended by the reviewer, **Dr. Gareth Nelson**, curator at the American Museum of Natural History in New York City.

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Kohn, D. (Ed.) 1985. The Darwinian Heritage. Princeton: Princeton University Press.

*Laurent, G. 1987. *Paleontologie et Evolution en France 1800–1860: Une Histoire des Idees de Cuvier et Lamarck a Darwin.* Memoires de la Section d'Histoire et des Techniques, no. 4. Paris: Comite des Travaux Historiques et Scientiques. 550 pp. 350 Francs. (Outstanding description of important evolutionary thought, pre-Darwin and non-British.)

Mayr, Ernst. 1991. *One Long Argument: Charles Darwin and the Genesis of Modern Evolutionary Thought.* Cambridge: Harvard University Press. xv+195 pp. $19.95 (Described as rather "myth-making" by a reviewer.)

Richards, Robert J. 1992. *The Meaning of Evolution.* Chicago: University of Chicago Press. xvi+205 pp. $19.95. Analyzes how Darwin fit in with 1830s-1840s ideas about morphology and embryology.

Dinosaurs, Spitfires and Sea Dragons by Christopher McGowan. Cambridge: Harvard University, 1991. $29.95, cloth.

Reviewed by Stephen M. Gates
University of Montana, Missoula

Can popular books on dinosaurs and other Mesozoic reptiles be educational as well as entertaining? There is still hope. In *Dinosaurs, Spitfires and Sea Dragons*, Christopher McGowan presents a wonderfully rigorous introduction to the functional analysis of dinosaurs, pterosaurs and ichthyosaurs. McGowan, a Curator of Vertebrate Paleontology at the Royal Ontario Museum and a University of Toronto Zoology Professor, displays his expertise by effortlessly merging paleontology and zoology in a book that strikes an excellent balance between scientific integrity and fun. His purpose is "to explore how Mesozoic reptiles lived and functioned and, in so doing, to gain some insights into the underlying reasons for their success" (p.3). To this end he has assembled much of the background information he uses to interpret fossil animals.

Three introductory chapters bring readers up to speed on some of the basics of vertebrate paleontology and function. The first concentrates on the mechanical properties of biomaterials such as bone, cartilage and tendon. This is followed by a chapter on the nature of paleontological data. In it McGowan describes the process of fossilization and outlines many of the events between the death of an animal and its preservation that distort the fossil record. Finally, a general introduction to the tetrapod body plan and terrestrial locomotion is given to form the foundation for the analysis of

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vertebrate skeletons. Throughout these chapters McGowan's concise writing style is a pleasure to read. He explains relatively complex biological and mechanical problems clearly and simply. Terminology is introduced gradually and builds upon earlier chapters so that the reader is prepared to address the complexities of functional interpretation.

In an excellent chapter called "Reading A Dinosaur Skeleton," McGowan cautions that, "There are limitations to what we can learn from fossils and we must constantly be aware of these," but goes on: "Forewarned of the pitfalls, we can proceed to examine a dinosaur skeleton and see what it can tell us about the animal that once gave it life170 (p.54). He begins with the hadrosaurs or duck-billed dinosaurs, addressing their locomotor feeding and sensory capabilities, and finishes with a brief look at the carnivorous theropods.

McGowan's conservative slant is evident when he discusses techniques used to estimate walking and running speeds in dinosaurs. R. McNeill Alexander (1976) described a relationship between stride length, limb size and locomotor speed in living animals and used this empirical data to formulate an equation. He then measured the stride length of fossil trackways, estimated limb size from the footprints and entered these numbers into his equation to predict the speed of the trackmaker. McGowan's skepticism is apparent when he recounts that "Paleontologists seized upon the equation with unrestrained enthusiasm . . . [yet] . . . Most of these estimates were made without a second thought being given to the reliability of the method." (p.61). After addressing the many weaknesses inherent in the technique, he concludes that it can not be trusted to make estimates of absolute speeds.

Many dinosaurs were incredibly large, and McGowan commits a chapter to the mechanical and physiological effects of body size. Much of this deals with sauropods (such as *Brontosaurus* = *Apatosaurus*) and their solutions to supporting, moving and maintaining their massive bodies. Using data from elephants, giraffes, Komodo dragons and other living animals, he clearly describes the implications of being a giant. One of his more forceful conclusions runs counter to the currently popular opinion that sauropods could stand bipedally (using the tail to form a tripod) to reach food high in trees. McGowan writes, "The idea that sauropods reared up on their hindlegs . . . can be dismissed on the grounds of blood pressure problems alone. Even holding their heads as high as depicted in most mounted skeletons would have presented serious problems" (p.120). His notion of multi-ton sauropods as leisurely, unhurried animals differs dramatically from the agile reconstructions of Robert Bakker (1975, 1986) or Gregory Paul (1987, 1988). It also forces us to examine critically the newly mounted sauropod *Barosaurus* at the American Museum of Natural History in New York, which is posed on its hind limbs with its head towering 50-60 feet above the gallery floor.

Discussions of sauropod physiology naturally lead into the debate about warm-blooded versus cold-blooded dinosaurs. McGowan clearly defines terminology and summarizes thermoregulatory strategies in living animals.

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He continues with discussions of locomotor stamina, muscle fiber types and the effects of limb posture on respiration. Various lines of evidence are reviewed to make conclusions about dinosaurs. He finally takes a mildly conservative stand. He is not willing to support high metabolic rates and body temperatures in all dinosaurs as proposed by Bakker, but is open to endothermy in the small, carnivorous theropods and inertial homeothermy (relatively constant temperature due to bulk) in large dinosaurs.

The dinosaur section finishes with a chapter on brains, intellect and behavior. McGowan presents an admirable synopsis of the anatomy and function of regions of the vertebrate brain. The reader is then introduced to cranial endocasts, the encephalization quotient and the drawbacks of estimating brain and body size in extinct animals. He ends with the behavioral implications of relative brain size in several dinosaurs and the facts behind the rumored "second brain" in *Stegosaurus*.

McGowan then turns to icthyosaurs, the finned marine reptiles he affectionately dubs "sea dragons" in the title of his book. Icthyosaurs have been the focus of much of MCGowan's personal research, so it is not surprising that he spends three full chapters on these creatures. The first chapter in this section describes the discovery of icthyosaurs and presents a brief history of their scientific study. This may seem out of place in a book emphasizing functional analysis of fossils, but it forms a nice transition from the dinosaur section. Next is a cogent summary of swimming mechanics. General concepts such as drag, laminar flow, streamlining and the Reynolds number are presented with helpful figures and a few simple formulas. An analysis of swimming in sharks and other fish sets the stage for a chapter on the interpretation of icthyosaur locomotion. McGowan completes this section with a review of icthyosaur genera from the Triassic, Jurassic and Cretaceous.

The Spitfires of the title are flying reptiles, the pterosaurs. He objectively discusses the ongoing debate over terrestrial locomotion in pterosaurs. For the past decade, Kevin Padian (1983, 1987) has argued that pterosaurs were agile bipeds when on the ground, rather than the ungainly, bat-like quadrupeds of more traditional reconstructions. McGowan gives even-handed coverage to the evidence on both sides, but confesses, "Which is the correct view? . . . if we had adequate data there would be no issue" p.263). His final conclusion is that "there do not appear to be any good grounds for ruling out the possibility that pterosaurs may have been bipedal" (p.266). The remainder of the pterosaur chapter focuses on flight. Aerodynamic principles are introduced (Spitfires and Messerschmitts are used to help explain aspect ratio, wing loading and flight performance) and form the basis for an interpretation of light in the large, crested pterosaur *Pteranodon*.

The last chapter addresses the mass extinction at the end of the Cretaceous. McGowan smugly summarizes the fiery debate that continues to smolder: "Sides were taken—catastrophists on the one hand, gradualists on the other. The media enthusiastically supported the catastrophists—sudden death from

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outer space made a far more interesting story that a lingering death from earth-bound causes" (p.293). He uses an effective question and answer format to evaluate the physical and paleontological evidence, concluding that the Earth was "struck by a large bolide" (p.301), but that "The turmoil at the end of the Cretaceous was just the *coup de grace* for those that remained" (p.311).

My primary grievance with this book is the almost complete absence of phylogeny, the evolutionary relationship between organisms. Although McGowan clearly states that he is working "within the framework of Darwinian evolution" (p.4), animals are not examined in a comparative context. This approach is prevalent in the study of biomechanics, but a major thrust of morphology (the study of form) in recent years has been to evaluate how differences in form and function evolved through time. McGowan presents case studies of particular animals as machines, but we must keep in mind that each of these "machines" contains many parts (and often a general blueprint) inherited from "older models" through ancestry. It is by tracing modifications through a phylogeny that we can truly begin to appreciate how form and function evolved. I do not advocate McGowan spending pages and pages on systematics, but its absence does weaken the book. Readers can look elsewhere for current theories of relationship in dinosaurs, yet a few simple cladograms (branching diagrams to denote the relationship of taxa) would quickly fill this gap.

A second criticism is the paucity of illustrations in some areas. McGowan communicates well with words, but often a figure would clarify his discussion. For example, there are only three micrographs illustrating the entire chapter on material properties. The meaning of terms such as stress, strain, compression, tension, elasticity, stiffness and Young's modulus is much easier to understand with simple graphs and diagrams. Similarly, when discussing locomotion McGowan writes, "The graph of stride frequency plotted against speed would therefore depict the gallop as a straight line with a very slight slope" (p.47). Why not just include a small graph to make this point visually? In other instances, adequate labels would make figures much more meaningful.

Overall, however, McGowan has achieved a delicate balance. The information is accessible to general readers, but not watered down. Students and professionals will appreciate his succinct treatment of topics and extensive bibliography. The book might easily have been titled, "An Introduction to Functional Vertebrate Paleontology," but this could have intimidated many who can benefit from it. Scientists should not let the charming title distract them; this is not a pretty coffee table book without substance.

In the recent spate of dinosaur books intended for the general readership, this book stands out for its level-headed approach. In his prologue, McGowan writes,

> People often ask me at the Royal Ontario Museum how we know the color of dinosaurs, what sounds they made, how fast they ran, how long

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> they lived, and so forth. When I reply that we simply do not know these things, I sometimes get odd looks. Surely we know . . . some paleontologist said so on the television . . . I read it in a dinosaur book . . . there was this article in a science magazine. The point I always make is that we do not know everything about living animals, so how can we possibly know so much about animals that disappeared over sixty million years ago? (p.1).

This candid admission of the paleontologist's bane sets a refreshing tone for the entire book. He warns that, "The words *may*, *perhaps*, and *possibly* therefore appear frequently, as I make very attempt to avoid straying beyond the data, but this does not mean that we will not take off on some flights of fancy together, nor avoid having some fun" (p.2). Statements such as this might not be immediately satisfying to those in search of *the* answer, but this makes his work *more*, rather than *less* engaging.

McGowan's book is most powerful in its portrayal of how functional paleobiology is actually done. Unlike Robert Bakker's *Dinosaur Heresies* (1986) or Gregory Paul's *Predatory Dinosaurs of the World* (1988), McGowan's work presents all sides of controversies and gives full credit to scientists working in each field. McGowan is not out to be a heretic, to belittle the more "traditional" hypotheses of past workers or to glorify dinosaurs. Although his own opinions are clear, they do not dominate. The reader is left to interpret the evidence and develop his or her own conclusions. This straightforward style differs dramatically from that of Bakker and Paul, in which personal interpretations are often presented as obvious truths and previous hypotheses are deemed ridiculously naive. I can only hope that McGowan's restraint will impress others to produce books of this caliber in the future.

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The Evolutionary Conspiracy. A Quantum Leap Into the New Age
Produced by Jeremiah Films, Hemet, California

Reviewed by Robert J. Meier and Keith P. Jacobi, Department of Anthropology, Indiana University, Bloomington, IN

As if the disciples of creation science were not sufficiently challenged in combatting orthodox evolutionary science, along comes the New Age Movement that conspires to transform organic evolutionary processes to a spiritual realm. Or so it would appear from a video program entitled, *The Evolutionary Conspiracy. A Quantum Leap Into the New Age*. Produced by Jeremiah Films, Hemet, California, *The Evolution Conspiracy* purports to document a developmental connection between New Age thinking and the basic biological evolution model espoused in Darwinism.

The video program has what we would call certain peculiarities, along with some expected portrayal of the ingrained controversy between evolutionists and creation scientists. For instance, we initially viewed the program as an attempt to join aspects of New Age philosophy with creation science thinking, but that seemed highly unlikely, given the clear rejection that creation scientists have announced toward the "New Age Movement" (Morris, 1987). We showed the videotape to two classes in human evolution and these students also came away linking New Age with creation science. Puzzled by our initial impression we wrote to John D. Morris Ph.D., at the ICR for a clarification. He figured prominently in the video program, along with several well-known creation "science" personalities (including Bill Keith, Luther Sunderland, James Kennedy, Larry Maclean and Wendell Bird). On the other side several evolutionists were interviewed (such as Tim White, Donald Johanson and Vincent Sarich). Morris responded to our query by pointing out that we had indeed misunderstood the program since the producers of *The Evolutionary Conspiracy* directly opposed the New Age Movement, and had designed this video, in John Morris' view, "to shock the listener into the realization that a religious viewpoint is being passed off in the name of science."

We returned to study the videotape, taking special care to see where we went astray. Further, we attempted to track down a book bearing the same title as that of the film, coauthored by Caryl Matrisciana and Roger Oakland, and promoted at the beginning of the program itself. We learned that the book has been published by Harvest House, Eugene, Oregon. Another book by Matrisciana, *Gods of the New Age*, does spell out in no uncertain terms her disdain for New Age spiritualism. (There is also a four-part film based on

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this book.) In addition, at the end of the video a second Evolution Conspiracy program was announced that would deal with the evidence for creation. This appears to be in the "Coming Soon" category.

Armed with a clearer background, our subsequent viewing of the videotape straightened us out, to a degree. Well along in the program there is the statement calling for Christians to come fully informed as to what is going on vis-a-vis evolution and the New Age Movement, so that they can be effective witnesses. However, we remain puzzled by the manner in which the film attempted to convey this message. Except for some brief discussion of New Age thinking at the start of the program, this them did not return until the very end, and then it was embedded in standard arguments of creation scientists related to teaching the two-model approach in schools and the evils brought forth by Darwinism.

Could it be that others were a little confused by this film? We were informed by John Morris that a shorter version of the film is being considered minus the New Age conclusion. He states, "I feel that the discussion towards the end did not build on the controversy as presented earlier in the program and that the material before would be better by itself." So perhaps a change in the film and its title is underway.

We have not addressed the bulk of the videotape as it relates to the evolution/creation science controversy in this report mainly because there didn't appear to be any new developments. Oh yes, you will be told that vitamin D deficiency causes arthritis; at least it did in the case of Neandertals. You might also be intrigued by the abrupt appearance-disappearance (almost a subliminal image) of Shirley MacLaine right at that start but you will have to wait until the end of the program before you hear her receive a proper introduction. We cannot end without saying that this film fails to establish any plausible connection between current mainstream evolutionary thinking and New Age spiritualism. While it may well be that the producers discovered proponents of the New Age movement who think that humans are a transition between apes and God, this does not constitute a conspiracy on the part of evolutionists as a group. Indeed, evolutionists, for the most part, have been rather vigorous in their attempts to quash creation science, and we are not aware of any New Age thinking permeating the ranks of serious evolutionists.

We would be interested in learning from any readers if they have viewed this videotape. Perhaps an updated version of the program will be distributed through Jeremiah Films as well. You can obtain a list of available videos from Jeremiah Films, P.O. Box 1710, Hemet, CA 92343, 800–828–2290 (outside California) 800–633–0869 (inside California).

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Evolution and the Myth of Creationism: A Basic Guide to the Facts in the Evolution Debate

by Tim M. Berra. Stanford: Stanford University Press, 1991.

Reviewed by David Glyn Nixon, Department of Anthropology, University of Massachusetts-Amherst

Berra's goals are to explain the theory of evolution to people who have been confronted by creationists, to provide ammunition to discredit creationist claims, and to offer a supplemental text for entry-level college biology classes. The book is strongest in its clear discussion of important, yet difficult to understand, topics. Organized as a lavishly-illustrated survival manual, it leads the reader through the basics of evolutionary theory. Key words and concepts are printed in boldface, indicating their presence in the glossary. Each chapter is infused with Berra's outrage and urgency that creationists' challenges have blighted the quality of American scientific education for so long.

The book has four units: the preface, the first four chapters, the final chapter, and reference materials. The preface, besides listing the obligatory acknowledgements, is a call to arms. It outlines the reasoning behind this book and places it in the context of the creation/evolution crisis.

The first four chapters deal almost exclusively with the fundamentals of evolutionary theory and scientific explanation. Creationist explanations are brought up only as asides, almost afterthoughts. Berra discusses such topics as human evolution, the age of the earth and the universe, the evolution of life, population and gene dynamics, geologic time, and the fossil record. Readers looking to debunk favorite creationist arguments will find plenty of useful information in these chapters.

In the final chapter, Berra confronts creationism head-on. Here, he outlines the state of American science education and the scope of the creationist movement. Drawing from materials contained in the previous chapters, Berra assaults creationist arguments in a "See, you can do it too" style. Parts of this

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section read like exercises at the end of a lesson, and perhaps it is meant to empower the lay reader.

In the final section, there are two appendices and a glossary. Appendix A covers the basics of chromosomes, genes, and genetic variation. The reader is walked step-by-step through mitosis, meiosis, replication and mutation, transcription, and translation. Illustrations and plain, if technical, language are used to describe evolution and reproduction at the cellular level.

Appendix B is a chronology of Charles Darwin's life. Its insertion is a bit of a puzzle—a hagiography, unrelated to the book's stated goals. The final section covers reference materials, including an excellent glossary—a unique and powerful feature—and an extensive list of further readings.

The book is not without weaknesses. One of its failings is that in an attempt to translate difficult theory into plain language, several questionable metaphors are employed. For example, one of the favorite creationist claims is that if one finds a watch, then one can deduce the existence of a watchmaker, implying that whenever organization exists (e.g., life), there must necessarily have been someone to create it. Berra justly criticizes this old line but then makes the unfortunate blunder of using it himself to illustrate some important points about evolution. This occurs on pages 118–119, where he uses automobile design as an analogy of descent with modification, and on page 126, where bicycle assembly is supposed to refute creationists' arguments about the second law of thermodynamics. These are serious errors, and creationists are sure to pounce on them.

Berra compounds these errors in his discussion of the creationist movement (see especially pages 142–144). As part of his analysis, he uses evolutionary parallels to describe the cultural phenomenon of a political, social, and religious movement, and quite simply the exercise fails. The temptation to equate human cultural processes with biological processes is an old and discredited tradition (see Godfrey and Cole 1979 for one discussion).

Oddly, Berra ignores cladistics, a major issue in contemporary evolution and anti-evolution.

Berra's trivialization of the creationist sociopolitical movement as simply "wrong" is echoed by many proponents of evolution and critics of creationism (e.g., Nelkin 1982, Strahler 1987). Because we constrain ourselves by dismissing creationists as being special-interest religious fundamentalists, we risk ignoring the threat that rising fundamentalism poses in broader social realms apart from science curricula. The task remains to understand how and why fundamentalists in general, and creationists in particular, are situated in struggles over economic, political, civil, and moral domains (see Cole 1983 for a discussion). Part of this effort should establish the identity of fundamentalists and what social processes make fundamentalism an attractive option for so many people in the United States.

Despite faults, Berra has provided teachers, school administrators, concerned lay people, and students of biology with an important resource

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in the continuing struggle against diminished science curricula in public schools and scientific achievement among students. As Berra states in his preface, "I am writing for the open-minded reader who does not understand the technical issues of evolution, but would like to, who sees everywhere the signs of a bitter philosophical and educational debate, but does not know what to make of it, or who to believe" (page ix). Berra's book will familiarize the reader with evolutionary theory enough to confront scientific creationism, but the reader will want to seek other materials to confront the creationists themselves.

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The Earth Is Not Moving
by Marshall Hall. Athens, GA: Fair Education Foundation, 1991.

Reviewed by Francis Graham, Astronomy, Kent State University, East Liverpool, OH

When "scientific" creationism first made its presence felt in the court systems, a number of political cartoonists depicted that next a motionless Earth would be introduced, as a humorous example of American science education going backwards into the Dark Ages. Their lampoon proved prophetic with the publication of Hall's *The Earth Is Not Moving*, the latest in a group of books which seeks to establish "Biblical Astronomy," i.e., geocentrism.

Whereas Dr. Gerardus Bouw's geocentrism book *With Every Wind of Doctrine* was a detailed literalist's catalog of Biblical geocentrist verses and their interpretation in a geocentrist way (plus some beatification of Tycho thrown in), and Van der Kamp's *De Labore Solis* was an affected pseudophilosophical stab at Copernican underpinnings, Hall has written for the vast audience of people who take their Bibles literally—but not too carefully—and who also do not understand much if any physics. Accep-

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tance of Hall's thesis is also enhanced if the reader is distrustful of science. Because of this large prospective audience, Hall's book and other geocentrist books of this genre may be very successful in the long run, and worthy of note.

In brief, Hall considers Copernicanism a Satanic Lie, and does not shy away from saying this over and over. Indeed, "lie" is one of the most extensively used words in the volume, capitalized and uncapitalized. In "Kepler: The Witchcraft Connection" we find: "Mr. Kepler was a demon-led loonie bird"; Quoting Kepler's First Law, he comments: " 'The planets move around the sun in ellipses having the sun at one of the foci.' Foci. Schmoki. Loci. Poci. If the sun is one of the foci, wonder what the other foci is, er ah, are?" (*Sic*). In "Einstein": "As a Zionist Jew, Einstein was an implacable enemy of Jesus Christ and His New Testament. That New Testament says plainly that all who deny that Jesus has come in the flesh as the Son of God are liars and anti-Christs." And "Einstein is one of the most outstanding figures in world history because he accomplished a task that Satan has been working on for centuries." He also reports, almost verbatim, a story, originated by the Nazi Lenard, of how Einstein's ideas were plagiarized.

Whereas previous geocentrists have used pieces of scientific theories to explain their pseudoscience, such as Bouw's using the Coriolis Effect as a real force caused by a rotating Universe, Hall dismisses all of the proofs of a moving Earth as lies: "The Coriolis Effect is a demonstrable reality which results when something is in motion over a rotating base. But applying this demonstrable reality to the Earth which has never been shown to be moving is a contra-scientific deception!"; "It is He and His Word that the Foucault Pendulum calls a liar!" He also denies most every other proof, such as the existence of a tidal bulge, in spite of the fact that every surveyor must correct for the difference between geographical and geocentric latitude (which is caused by the oblateness of the Earth's shape).

This is the flavor of the whole book. "The enormous deceptions of heliocentricity and evolutionism are like two great flood gates that contain a hidden lake full of Satan's deceptions!"

And yet, in spite of his professed disdain for lies, Hall tells a few himself. "In fact, although scarcely anyone knows it, Brahe's non-moving Earth model is used today in all the applied sciences including practical astronomy, space travel, and eclipse predictions"(p. 42). All of the space travel programming I've seen use Newton's Laws, which certainly do allow for a moving Earth. One of the more popular orbital mechanics programs used in the space industry is the PC-compatible "Orbit View" from Cygnus Engineering. Order their demo disk and watch the Earth rotate.

In a section called "The Coriolis Flim-Flam" (p.160) we find "Gravity exerts a force of about fourteen point something pounds per square inch at the most." It is clear that Hall doesn't understand the most elementary physics and is really deceiving himself to imagine that he can write a critique of all

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of it. But why bother to understand anything that must be a lie, for "This kind of stuff gets too heavy for my brain otherwise" (p. 161).

Hall's advocacy is rooted firmly in the Biblical literalism of Joshua 10, Psalm 93, and other geocentric Bible verses, for he says: " . . . the whole purpose of this book is to show that the Scriptures tell the Truth on this subject (and by extension all subjects!)". Then he quotes Psalm 19:

"In them [the firmament] hath He set a tabernacle for the sun, which is as a bridegroom coming out of his chamber, and rejoiceth as a strong man to run a race. His going forth is from the end of heaven, and his circuit into the ends of it."

And then Hall comments: "OK. I've got the picture. The Bible teaches that the Earth is hung on nothing, that it is fixed in a certain spot and cannot be moved, and that the sun goes around it in an orbit every day . . . "

But that's not what Psalm 19 says. What about the "tabernacle" that the sun comes out of? Where is it? Hall doesn't explain, for like all of the heliocentric Christians he condemns as Satan's tools, he also compromises the Bible to suit his Tychonic model fancy. As R. Schadewald pointed out in two articles in the *Bulletin of the Tychonian Society*, the Bible favors a flat-Earth model with this verse, and the sun hides in the tabernacle to explain night on the flat Earth. But then, maybe Psalm 19 is just poetic. But either there is a tabernacle for the sun or there is not.

In Hall's chapter, "Mathematics—Liar in Truth's Clothing" he recounts the torture in Orwell's *1984* where the torturer, O'Brien, held up four fingers and demanded that his victim, Winston, see five. In that same torture session is a passage conveniently omitted by Hall:

" 'What are the stars?' said O'Brien indifferently. "They are bits of fire a few kilometers away. The Earth is the center of the Universe. The sun and stars go around it.'

'For certain purposes, of course, that is not true. When we navigate the ocean, or when we predict an eclipse, we often find it convenient to assume the Earth goes round the sun and that the stars are millions upon millions of kilometers away. But what of it? Do you suppose it is beyond us to produce a dual system of astronomy? The stars can be near or distant, according as we need them. . . . Have you forgotten doublethink?' "

And doublethink is precisely the fate of millions of American children indoctrinated to the nonsense of scientific creationism and Biblical astronomy and then asked to perform as biologists, biotechnicians, geologists, virologists, surveyors, astrophysicists, physicists and engineers. Do we want a population like that?

In spite of all these negative things about the book, or rather because of them, those who are concerned with the effects of religious fanaticism in educational programs should read it, for the Dark Ages are back. C/E

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Correspondence

How Not to Argue with Evolutionists?

• *"How Not to Argue with Creationists" by Jim Lippard (Issue 29, pp. 9–21, 1992) is strongly critical of two Australian anticreationists, Ian Plimer and Barry Price. [Editor] John Cole defends Lippard as showing "our openness to self-criticism" [in his introduction]. But Lippard is not criticizing himself, he is criticizing somebody else. Furthermore, there is no need for Lippard's article; the Australian Creation Science Foundation has attacked Plimer and Price at length in its publication, "Response to Deception," referenced and quoted by Lippard. Why should Creation/Evolution join forces with creationists? Duane Gish, who is defended by Lippard, is an expert at taking care of himself (Jukes, Nature 305:398, 1984).*

Lippard seems insensitive to the problem of "cultural imperialism," meaning the tendency to take on the uninvited role of passing judgement on disputes in other countries. As a former resident of Canada, I know how strongly interference by the USA is resented by Canadians. I consider Lippard's intrusion into the Australian scene to belabor Plimer and Price to be an embarrassment. Inconsistently, Lippard is supportive of Michael Denton, an Australian anti-evolutionist whose book Evolution, A Theory in Crisis, a favorite of creationists, is of low quality. Denton can't even construct phylogenetic trees (Jukes, Basis 10:1, 1991, Bay Area Skeptics).

Lippard's article was ill-advised and divisive.

Thomas H. Jukes
Dept. of Integrative Biology
University of California-Berkeley

Afrocentrism

• *I am puzzled by the point and purpose of Bernard Ortiz de Montellano's essay on "Afrocentric Creationism" (C/E 29: 1–8). In spite of the title there is no presentation of a creationist myth being advanced as an alternative to evolution. There is also no discussion of Afrocentrism. Rather there is presented a collection of some pseudo-scientific notions of those he labels "melanin scholars" (always lower case in quotation marks). In classic straw-man method these "scholars" are equated with Afrocentrism while being demolished with Montellano's ridicule. It is a performance worthy of Duane Gish and one to be deplored as Jim Lippard points out in "How Not to Argue with Creationists," pp. 9–21.*

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Since this essay has just about nothing to do with either creationism or Afrocentrism, I am forced to wonder why Montellano wrote this essay with this title and why it was published in C/E. Could it be that there is some less than purely scientific concern with Afrocentrism's claims regarding the origins of scientific thought—claims that suggest that all scientific wisdom and discovery has really not been the work of white European men? We are quick to point out the creationists' hidden agenda of smuggling religion into the science classroom. What is the hidden agenda here?

Peter E. Kane
Churchville, NY

• *The day after my copy of C/E 29 arrived there were two related stories in the* Harvard Crimson*: one, plus editorials and letters, was devoted to the largely-attended talk here by Leonard Jeffries [CUNY professor and leading Afrocentrism advocate]. His talk was devoted—slightly muted—to doctrines described in your lead article by Ortiz de Montellano. The other story, about a talk on God and the improbability of a chance origin of life on earth [by Dr. Walter Bradley of Texas A&M], was exactly what your p. 22 article by Landau and Landau was intended to refute. [Jeffries and Bradley audiences need C/E.]*

Robert Davis
Cambridge, MA

Coming in future issues . . .

- Looking for lighthouses—how a 19th century flat-earth argument illustrates the nature of "modern" creationism
- A fishy teeth tale—Cretaceous Texas "human teeth" exposed as fish incisors
- Critiques of Phillip Johnson's *Darwin on Trial*
- The creationist movement viewed from North Carolina
- "Appearence of age"—a view from Jewish scholarship
- Australian antievolutionism
- and (of course) more, more, more . . .

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